STRATEGY RESEARCH PROJECT

BUILDING SAFER COMMUNITIES: TRAINING TO SUPPORT THE NATIONAL MITIGATION STRATEGY

BY

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ABSTRACT

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The Federal Emergency Management Agency's National Mitigation Strategy presents "A Vision for Safer Communities in the Future," looking toward the year 2010 as a time when "All new structures, including critical facilities and infrastructure, will be built to national multi-hazard standards incorporated into building codes that have been adopted and enforced by municipalities, counties, and States."

The Strategy not only articulates FEMA's mitigation vision and goals, but defines strategic objectives for reaching those goals. In the area of applied research and technology transfer, FEMA and its partners are directed to "evaluate state-of-the-art technologies for the dissemination of research results to the user community." A companion objective in the area of public awareness,

training and education requires "an assessment of the most effective use of information technologies such as the Internet and other media to disseminate information on natural hazards and mitigation. . . ." This paper is the outgrowth of a search for effective ways of meeting those objectives.

This paper explores the feasiblity of encouraging practicing architects and engineers to incorporate research findings in the design of new structures by providing training on-demand, in the form of Electronic Performance Support Systems (EPSS), via the Internet and the World Wide Web (WWW).

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Building Safer Communities: Training to Support the National Mitigation Strategy

Saving lives and protecting property, the mission of the Federal Emergency Management Agency (FEMA), is not solely a matter of rescue and response, of feeding and sheltering, of apportioning Federal resources to help families and communities rebuild. Disaster mitigation encompasses those activities which can be undertaken in "peacetime", years before an incident, to increase the likelihood that homes, workplaces and essential government facilities can survive the impact of a natural disaster. Analysis of building performance in past disasters has shown us how to design disaster-resistant structures, those with a higher likelihood of surviving the impact of a natural disaster.

But research in building design doesn't save lives until it is reflected in the design of structures in an actual community. Getting the latest information, formulas and design tools into the hands of building professionals is the challenge for FEMA's training arm, the Emergency

Management Institute (EMI). This paper explores the feasiblity of encouraging practicing architects and engineers to incorporate research findings in the design of new structures by providing EMI training on-demand, in the form of Electronic Performance Support Systems (EPSS), via the Internet and the World Wide Web (WWW).

The Impact of Natural Disasters

Hurricane Marilyn. The Loma Prieta earthquake in San Francisco and the Northridge earthquake in Los Angeles. The great Mississippi/Missouri river floods of 1993. Heavy snows collapsing buildings in the Pacific northwest. A conflagration that transforms a hotel into a "towering inferno."

Images of disaster fill our television screens. Families being rescued from flooded homes. Lawn chairs sailing like frisbees through plate glass windows; roofs rising like kites. Cars crushed on the Nimitz freeway. A charred skeleton the only relic of a thriving small business. A heavy-rescue team crawling through the debris of a collapsed building; the depression evident in the demeanor of the rescue dog who senses that the person he has located is already dead.

The cost of natural disasters is staggering. In one year alone, 1996, the Federal Government authorized 79 major disaster declarations. Furthermore, the cost of each natural disaster goes far beyond the initial response and rescue activities shown on the nightly news. Homes and businesses must be rebuilt - and many small business will perish under the combined weight of physical and financial ruin. A major corporation whose local facility suffered severe damage may choose to relocate, triggering a loss of jobs and tax revenue that can threaten the future of the community. Schools may be closed for extended periods,[1] requiring that students be bussed to distant facilities, or crowded into usable classrooms.

The national burden of natural disasters goes far beyond the Federal assistance provided by FEMA.[2] Added to this are the private resources consumed by these disasters: insurance costs, so significant for major insurers in south Florida after Hurricane Andrew as to trigger a major insurance crisis in that State,[3] as well as the funds, goods and services provided by voluntary organizations. Also significant are the costs borne by the States and local

governments impacted, which normally contribute 25% of the cost of a declared disaster.

President Clinton spoke for many Americans when, in December 1995, he wrote " . . . the time has come to mount a nationwide effort focused on reducing the impact of disasters as well as reducing their economic consequences."[4]

Birth of The National Mitigation Strategy

Not only are natural disasters increasingly expensive, but their impact may well be increasing. FEMA Director James Lee Witt clearly articulated the challenge: "As more and more Americans have chosen to live along ocean or inland coastlines or in areas of seismic risk, often with little or no attention to the need for sound building practice or land use policy, the risk from natual hazards has grown exponentially. By the year 2010, the number of people residing in the most hurricane-prone counties (now 36 million) will have doubled, as will the number of those living in the most seismically active regions."[5]

Traditionally seen by the public as a disaster *response and recovery* agency, FEMA was reshaped by Director Witt into an agency with a clear focus on disaster *mitigation*, defined as "sustained action taken to reduce or eliminate long-term

risk to people and their property from hazards and their effects."[6]

FEMA's strategic plan Partnership for a Safer Future presents the envisioned end-state: "An informed public protecting their families, homes, workplaces, communities and livelihoods from the impacts of disasters; hazard-resistant structures in communities located out of harms way . . . ."[7]

In 1995 FEMA unveiled the National Mitigation Strategy, which charts the way to achieving that vision. The Strategy is a product of the best thinking of all the partners in the mitigation effort, not only FEMA staff, but also their colleagues at the State and local levels, in other Federal agencies, and in the private sector. In addition to gaining input from these traditional partners, FEMA held a series of 11 public Mitigation Forums across the United States to gain grassroots input from citizens who are themselves exposed to the spectrum of the nation's hazards.[8]

Born of this dialogue, the Strategy presents "A Vision for Safer Communities in the Future", looking toward the year 2010 as a time when "All new structures, including critical facilities and infrastructure, will be built to

national multi-hazard standards incorporated into building codes that have been adopted and enforced by municipalities, counties, and States."[9]

The Strategy not only articulates FEMA's mitigation vision and goals, but defines strategic objectives for reaching those goals. Two of these objectives became the impetus for this paper. In the area of applied research and technology transfer, FEMA and its partners are directed to "evaluate state-of-the-art technologies for the dissemination of research results to the user community."[10] A companion objective in the area of public awareness, training and education requires "an assessment of the most effective use of information technologies such as the Internet and other media to disseminate information on natural hazards and mitigation. . . ."[11] This paper is the outgrowth of a search for effective ways of meeting those objectives.

What are the criteria against which proposed approaches can be measured? The Strategy itself asks the cogent question: "Does the mitigation effort effectively transfer ideas or technology to messages or products that can be

readily understood and applied by users to identify, assess, and mitigate natural hazards risks?"[12]

The phrase "readily understood and applied by users" thus became the litmus test for the current investigation.

Technology Transfer: We Can Build to Survive

Images of disaster fill our television screens, and often we respond with futility and hopelessness before these "acts of God." Lives lost, houses and businesses destroyed. Too often we resign ourselves to grief, lamenting, "What could we possibly have done in the face of the fury of the storm?"

Yet the truth is that human beings have the creativity to build communities, homes and businesses capable of facing the fury of most storms. Each disaster teaches how we can build to survive the next. FEMA, working with the National Institute of Standards (NIST), the Insurance Institute for Property Loss Reduction (IIPLR), professional associations such as the American Society of Civil Engineers (ASCE) and researchers in universities across the country, has focused on the lessons-learned from natural disasters. Researchers investigated performance of buildings and other structures[13] in the Loma Prieta earthquake that shook the San Francisco area in 1989, and the Northridge earthquake which disrupted

Los Angeles in 1994. Hurricanes Hugo, Andrew, Iniki, Marilyn and Opal yielded insights into building performance under heavy wind loads. Research into the performance of buildings, levees and other structures during recent floods has added to an already-extensive body of knowledge related to floodplain management.

We cannot yet build a disaster-proof community, warranted secure against all hazards. Nevertheless, we have learned much to help us achieve FEMA's goal of "building safer communities" for the citizens of this nation.

Training the Design Professional

Currently few colleges or universities offer courses in disaster-resistant design as part of their standard architecture or engineering curricula. Generally these principles, if taught at all, are referenced peripherally in the discussion of current model building codes, life safety codes or other standards. Unfortuately for the aspiring architect or engineer, there is little "standard" information on building codes which can be learned once only, in the college classroom, and applied uniformly across the nation. The young professional will encounter significantly different code requirements in a small

Pennsylvania community, for example, than he or she would have to address in a metropolitan setting in the Pacific Northwest.

The United States does not have a national building code. It is rare even for a State to promulgate or enforce a building code, and those States which do so generally provide only the most essential life-safety provisions. Traditionally building code adoption in this country is a local issue, with cities, counties, townships or municipalities adopting an ordinance which references one of the model codes, in whole or in part. Because code adoption is a local process, it is also vulnerable to local politics. Some (primarily metropolitan) jurisdictions may have strict codes, adhering closely to one of the model codes. Others may adopt a model code, but only in part, or with significant modifications. Rural areas, which often lack professional staff for code enforcement, may choose not to adopt a building code at all.

Currently there are three model building codes, developed by recognized organizations, generally working with a consensus input and review process that provides for representation by all affected parties. These include the

National Building Code, developed by Building Officials and Code Administrators (BOCA), the Uniform Building Code developed by the International Congress of Building Officials (ICBO), and the Standard Building Code, developed by Southern Building Codes and Congress International (SBCCI).

Model codes usually incorporate or reference standards, the most familiar of which are probably the fire safety standards developed by the National Fire Protection Association (NFPA). Fortunately FEMA and the disaster research community have often had input into the standard development process. The National Earthquake Hazard Reduction Program (NEHRP) underwrote development of seismic standards now referenced by several of the model codes. And FEMA is currently working with the ASCE as part of the team developing the new standard ASCE-7.

FEMA's Traditional Approach to Reaching This Audience

Notwithstanding these limitations, FEMA and its predecessor agencies have been committed to making the latest building performance and design recommendations available to the design community. In 1973 the Defense Civil Preparedness Agency (DCPA) initiated the Multi-

Protection Design Summer Institute, which originally addressed structural design for the attack environment. The creation of FEMA in 1979 broadened the mission to include natural disasters. Since then EMI has provided design recommendations based on recent disaster research to professors of architecture and engineering through annual Multi-Hazard Building Design Summer Institutes (MBDSI).

At each year's Institute, presentation and discussion of design principles are illustrated by printed materials, 35mm slides and computer software which have been developed with FEMA funding and are thereby in the public domain, open to reproduction and distribution. MBDSI participants are encouraged to incorporate these materials into undergraduate and graduate courses in building design, as well as to promulgate them through professional workshops and conferences.

In 1994, following development of the design reference manual for Retrofitting Flood-Prone Residential Buildings, EMI initiated a course on this topic for practicing architects, engineers and building officials. The bulk of the course references design principles for flood mitigation, including detailed investigation of design

considerations for elevation, flood-proofing, and the siting and construction of floodwalls. As a part of this course, participants develop cost estimates for each viable option. They also are taught how to do a manual and computerized benefit/cost analysis of the various feasible options.

Long-term evaluation of the MBDSI program[14], however, indicates that while we are reaching a percentage of architecture and engineering *students*, the MBDSI does not contribute toward placing new disaster-resistant design information in the hands of practicing professionals.

Just-in-Time Training For the Design Professional

Practicing design professionals must have access to state-of-the-art research findings if they are to design disaster-resistant structures. Few are aware of FEMA's interest in their profession; even fewer have the flexibility to spend two weeks at EMI discussing application of the latest research. Yet as each tackles design of a particular structure in a high-hazard area, he or she will encounter problems unique to that hazard. Ideally FEMA training should be available to the design professional at the point when the design problem presents itself. One

cannot ask a client to "Wait a few months 'til I take a course on earthquake design."

So, how can FEMA reach the practicing professional when the disaster-resistant design problem presents itself?

Design professionals routinely use computer software in design and analysis of building components. Many work with computer-assisted design (CAD) software. MBDSI participants have been enthusiastic in their reception of FEMA-provided software during the Institute. Anecdotal feedback from the MBDSI, as well as from leading professionals in the field[15], indicates that many design professionals are also users of the WWW, particularly as it supports interaction with professional colleagues and associations.

These characteristics of the target audience, coupled with the success of the business community in the use of EPSS, often distributed via corporate-wide intranets, led EMI to explore distribution of EPSS via the WWW as an companion effort to extend our reach into the building professions.

EMI Training: A Focus on Job Performance

EMI is primarily a training institution; its role within FEMA is to provide Federal, State, local and private

sector personnel the knowledge, skills and ability required to perform specific emergency management tasks or functions. Each of these tasks and functions usually has a clearly defined goal, product or end-state.

In the case of structural design professionals, FEMA's ultimate concern is to increase the percentage of disaster-resistant structures in hazard-prone areas. Therefore the training goal is not solely whether architects and engineers become current in research findings, but whether that training results in incorporation of those design principles into architectural concepts, engineering studies and actual blueprints. Giving these professionals knowledge about disaster-resistant design is an important goal, but it is even more important that we give them tools to incorporate those principles into new structures. The ultimate goal, from FEMA's perspective, is that new structures be more effective in protecting the lives and livelihoods of occupants.

Our current challenge in training practicing design professionals, therefore, is to put into their hands tools which they will use, tools which will guide them as they apply state-of-the-art design principles.

EPSS: Practical Tools for Improving Performance

Traditionally training organizations have fostered the transition from neophyte to expert through a series of classroom training experiences, supported by knowledge-acquisition elements such as readings, lectures and audio-video presentations. The move to performance-based instruction, using training objectives based on job/task analysis, led to classroom activities and simulations which attempted to re-create the job environment. We assumed that successful course completion meant that all relevant information was securely stored in the individual's head, all essential skills fluent and ready for performance.

The irony is that storing information and skills in an individual's head does not guarantee expert performance in today's complex work environment. Most professional jobs present varied situations to which simple, memorized rules will not apply. This is particularly true in emergency management, where even the job of fire dispatcher requires analysis and decision-making skills across a wide range of situations. Knowledge about our world, how it functions and how we function within it, is increasing exponentially. Last year's end-of-course mastery often means that today

both information and skill are out-of-date. Even if what students learn in class doesn't degrade with infrequent use, it will probably be superceded by subsequent research, development and innovation.

Fortunately the past ten years has brought the power of information technology to bear in the creation of computerized performance training tools, electronic performance support systems (EPSS), which can support a range of tasks and functions in a corporate work setting. Gloria Gery (1991) addressed the core strength of EPSS when she wrote, "The goal of an electronic performance support system is to provide whatever is necessary to generate performance and learning *at the moment of need.*"[16]

An EPSS supports the performer's accomplishment of a task in several ways. Traditionally, a professional facing a new or unusual problem consults with more experienced co-workers, peers and colleagues. In the electronic environment, an EPSS can provide a virtual cadre of instructors and librarians, advisors and assistants with expertise related to the task at hand. Where once the learner might consult manuals, photographs or other paper-based resources, he or she can now access these in the EPSS

via hypermedia links at the click of a button.[17] Furthermore, unlike human colleagues who may or may not be available to advise when an unusual situation is encountered, the EPSS is immediately available to the professional.[18]

An EPSS can have varied configurations, depending on desired performance objectives, as well as the operating environment and the baseline expertise of the performers. Central to most EPSS is an "infobase"[19], which may include one or several databases, a knowledgebase, and possibly visual data elements such as graphics, pictures, maps or films. An EPSS may provide an advisor[20] (an element also referred to as assistant, helper[21], or wizard [22]) to answer user questions. The advisor can also be an expert system designed to monitor and troubleshoot the learner's performance, intervening to ask pertinent questions or provide directive insight, clarification or suggestions.

Applications software (sometimes termed a "dofer"[23]) is often at the heart of an EPSS, providing a automated tool for task performance. These elements can be supported by help systems, either user-initiated or triggered by user error, which offer explanations or examples. On-line

instructional systems may also be a part of an EPSS; however, unlike traditional computer-based courses, an EPSS will generally offer instruction in "granular" sequences, short instructional elements specific to one task or sub-task.[24] Other optional EPSS components include assessment systems for evaluation of knowledge or skill, or other monitoring and feedback systems to assure acceptability of user performance.

A key issue in EPSS design involves provision for user choice and interaction with the tools provided by the system. An EPSS should allow each user to easily scan and select what is necessary for the task at hand. The use of hypertext/hypermedia can permit the user to move easily and quickly between layers of information[25]. A novice, for example, may require the assistance of librarian or advisor elements of the EPSS for orientation to the task at hand, as well as to guide selection of appropriate EPSS elements. A more sophisticated user, having determined that the case under consideration is atypical, may choose to move to deeper layers of the system. Here the user can access more sophisticated applications elements, or move through successive layers via hypermedia to review schematic

drawings, magnified cross-sections, or video-clips illustrating the nuances of the problem.[26]

An EPSS should also facilitate smooth linkage to other relevant systems. These may be housed on the user's hard drive or a workstation CD-ROM; alternatively, they may be resident on a facility's network or corporate intranet. Ideally, EPSS screens and software will be designed to be nearly intuitive for the target user population. Icons for access to help, advisor, librarian, training and applications elements can be graphically representative of their function. Standardizing the location of such icons on all screens of the EPSS makes it easier for the user to navigate its multi-layers. Transition to elements outside the EPSS should be smooth, whether the user is accessing information on-site through a network, or reaching beyond the facility via the WWW. A good EPSS provides quick, smooth navigational pathways to carry the user directly to needed tools, information or support.

How Do We Know They Work?

Initially EPSS have been most visible in corporate setttings, where they could be accessed via corporate intranet, or resident on computers at staff workstations.

Major corporations have found that EPSS not only reduce training time, but increase employee productivity and accuracy. IDS Financial Services reports that the "use of an EPSS-style front end for legacy system in bank operations" has "reduced errors (73% for existing employees, 87% for new), reduced time per task (33% for existing employees, 77% for new), reduced training and on-the-job training time (75% reduction in on-the-job training time)." Boston Edison uses an EPSS "to assist customer service employees", citing such benefits as "less time away from workplace, shorter on-the-job training time, novices perform as experts, cost savings in 1993 $39,000-$117,000."[27]

However, a corporate intranet is not essential to an EPSS. It is important to realize that an EPSS can also function as a stand-alone system resident on a hard drive or CD-ROM. The Innovis Design Center was developed in response to two phenomena: homeowners' desire to "design and build decks, shelving systems and garages for their homes," and recognition by home center retail stores and lumber yards of "the need to support their retail sales representatives in moving customers from dreaming to

actually building."[28] The resulting system, working "stand alone" at home centers and lumberyards, allows homeowners to design a deck, garage or other project to their own specifications, then prints out working blueprints and a detailed materials list for the project.

An EPSS may also support higher-level analytical and decision-making processes. Aetna Life and Casualty has developed the "Aetna Management Process (AMP) Facilitator software which provides performance support to managers or teams who need to apply AMP to a business plan or project."[29] [30] At AT&T the Training Test Consultant is an EPSS which helps trainers make better decisions about devising tests.[31]

EPSS products are now accessible to interested segments of the general public via the Internet and the WWW. Homebuyers Fair (www.homefair.com) provides tools to help homebuyers assess different mortgage scenarios, consider how a salary in one area of the country translates to cost-of-living in another, and estimate the cost of moving.[32] Particularly ubiquitous on the WWW, as the baby-boom generation ages, are financial planning EPSS which help a family analyze their spending and develop savings and

investment plans for goals such as education and retirement. Other EPSS are now coming to the Internet which help retirees manage their investments to assure that their money survives as long as they do.

Similarities Between the EPSS Development Process and Instructional Systems Design

The trainer new to EPSS development will encounter some comforting similarities in the process - and some challenging differences. Classic instructional systems design (ISD) models begin with job and task analysis in which the designer inventories not only all tasks related to a job, but the knowledge and skills required to complete each task. In EPSS design the designer must also consider how each element relates to the performance of the job itself, and further how it impacts the quality of the desired work product.

In ISD instructional objectives based on task analysis define learning goals. Training materials are then developed to help the learner attain those goals. The EPSS designer first focuses on work flow, assessing inputs and outputs at each stage of the task, documenting not only the steps in the process, but which resources are required,

which experts or advisors must be consulted, and which steps depend on successful implementation of others.[33]

Using the ISD model, trainers often focus on documenting the approach of the subject matter expert (SME) or expert performer. Because these individuals will often be part of the classroom instructional team, they can be counted on to answer questions raised by novice performers during the course of instruction. An EPSS, in contrast, must contain all resources necessary to enable successful performance on the part of the novice. Hence, EPSS designers must interview not only the SME, but also observe and query novices as they engage in task performance. Which steps are confusing? Which alternatives are not self-evident? Assessment of novice performance guides the EPSS designer in development of help, advisor and expert elements of the system.

The design team for an EPSS should include not only the instructional designer, assisted by SME's and novice performers, but also Instructional Systems (IS) practitioners familiar with the various electronic tools for creating an EPSS[34]. The IS staff are the experts in design of the user interface, experienced in the creation of

effective hypertext/hypermedia links. Unlike the experience of ISD practitioners, EPSS designers have found that moving quickly to a bare-bones prototype model enhances rather than truncates the design process.[35] The initial prototype facilitates further analysis of novice and expert performance, so that the design becomes an iterative process, with each succeeding version of the EPSS more effective in meeting performance goals.

Indeed, one can expect this iterative process to continue throughout the life of the EPSS. A system may be effective for experts and novices today, yet outmoded tomorrow. Organizational protocols and processes change. New research, court decisions or other external information may change the criteria for successful performance. As the "experts" evolve new approaches, the EPSS must be flexible enough to easily accommodate changes.

Recommendations: Using EPSS to Help Build Safer Communities

FEMA's National Mitigation Strategy, as discussed earlier, requires that mitigation products be "readily understood and applied by users."[36] EPSS by their very nature meet this criteria, thereby offering a practical tool for FEMA to provide training to the practicing design

professional. Furthermore, dissemination via the Internet and the WWW would make it possible for this audience to access an EPSS "on demand," as well as allow FEMA the latitude to provide updated EPSS to the design profession as lessons are learned after each disaster.

A simple EPSS to support the retrofitting of flood-prone residential buildings might be based on existing manuals addressing flood mitigation options such as elevation of a structure, creation of a protective floodwall, or relocation of the building. These, together with reference handbooks citing construction costs are already used by architects and engineers who advise homeowners faced with repairing damage to a flooded home (or families who, recognizing the dangers of living in a flood-prone area, prefer to mitigate before the disaster.) Benefit/cost computations comparing each option have already been computerized. When linked to local hazard and construction cost data in other files, these can automate and streamline the necessary calculations. Which is the best option for the homeowner? The benefit/cost analysis software is already a performance support tool, a simple stand-alone EPSS that enables design professionals who

infrequently do this analysis to provide clear, dollar-quantified options to their clients.

But what about the engineer now faced with design of the chosen mitigation option? Local topology and hydrology must be taken into account. Floodwaters have force, weight and mass. How will the designed structure withstand these pressures? Complicated engineering formulas assess these relationships. Currently these are available in reference manuals. However many of the most-frequently used formulas could be computerized. Post-disaster research and design experts' insights could be captured and an advisor capability added. The advisor would function as an on-line expert, helping designers unfamiliar with hydrologic concepts understand their implications. If local building codes must be considered, a librarian could also be created, providing access to text and graphic examples.

The Place to Begin

The situations cited above indicate that EMI already has a point of departure for the development of EPSS to support the design of disaster-resistant structures. The research has been done, and is updated annually and provided in paper-based format to participants in each summer's

MBDSI. An extensive engineering manual has been created to support retrofitting of flood-prone residential buildings. Benefit/cost analysis software for flood and earthquake mitigation options has already been developed in prototype, tested by expert and novice performers in the field, and revised and refined based on their feedback. An automated program for Nonlinear Dynamic Time History Analysis of Single Degree of Freedom Systems (NONLIN) provides the design practitioner or researcher the opportunity to explore the performance of various structural systems under the dynamic loads produced by earthquake forces.

Architects and engineers attending the MBDSI, as well as several other EMI courses, have worked with NONLIN and benefit/cost products in the EMI computer lab. Course designers, FEMA mitigation experts and software designers have modified these products in response to their input. Field engineers and architects, either as FEMA disaster-hires or contractors, have used the benefit/cost software following several recent disasters. This product has also been used by some state emergency management agencies in evaluating projects proposed for post-disaster mitigation grant funding.

Given the goal of building safer communities, however, FEMA would like to extend the reach of these and other mitigation tools beyond the emergency management community. These tools - and others like them, addressing design principles not yet captured in EPSS - should be available to every design professional, whether in the pre- or post-disaster setting.

Because of the nature of this audience, each training product should be designed to "stand alone." Unlike many of the business organizations cited earlier, FEMA's training audience is vastly larger than the relatively small number of agency staff. Although a few design professionals may work intermittently for FEMA as disaster hires, consulting with communities, businesses and individuals during the disaster recovery period, the majority of professionals in this area will never work for FEMA - most will never have personal contact with any FEMA employee. A FEMA intranet won't reach them. Neither will EMI have the opportunity to directly load EPSS materials to many design professionals' computers.

Nevertheless the lessons learned by the business community show us the parameters. An EPSS should be readily

available to the professional at the time the design challenge is encountered. It should be easily found, easily navigated. Granted, FEMA can't physically access their workstations, nor invade their corporate intranets. Structural design EPSS might be distributed on disk; unfortunately, this approach makes updating difficult and increases the potential for proliferation of outdated materials[37]. However the investment industries' use of the Internet and WWW[38] for dissemination of their financial planning EPSS offers FEMA another model. Design professionals are already experienced users of the WWW[39] and the Internet, particularly for interaction with professional colleagues, peers and the academic research community. This situation challenges us to make our EPSS tools as ubiquitous as possible within the electronic community.

Creating Signposts on the Information Highway

Key word linkages and identifiers should be created to facilitate access to EMI's structural design EPSS's via Internet search engines such as YAHOO[40]. Currently hypertext links within FEMA's own homepage eventually lead one to Training, the EMI, and thereby the MBDSI. From the bureaucrat's perspective, EPSS's are a logical sub-element

to the MBDSI listing, since they were initially a sub-element of that training program.

Professionals should also be able to access a design EPSS via hypertext links from FEMA's Mitigation pages which are of greater general interest to the design profession. FEMA needs to work with national professional organizations such as ASCE, to whom engineers routinely turn when seeking the advice of their colleagues, to establish hypertext links from their homepages. Contacts should also be made with relevant regional forums such as the Central United States Earthquake Consortium (CUSEC), and academic resource centers such as the Natural Hazards Center in Boulder.

Taking the First Steps

In November 1996 EMI made the NONLIN EPSS available to the design community via the FEMA homepage. NONLIN is currently available as subelement of EMI training information, hyperlinked from the description of the MBDSI (http://www.fema.gov/home/EMI/nonlin/htm). In December information was provided to YAHOO to facilitate NONLIN access through that search engine. EMI staff have contacted professional associations such as ASCE, as well as CUSEC and the Natural Hazards Center to discuss providing linkages

through their homepages. Leading design professionals (Topping, 1996) have suggested also "getting the word out" via professional publications.

System administrators of FEMA's homepage have agreed to count the number of "hits" or visits to NONLIN, and will also provide us information on the number of times that EPSS has been downloaded. Demonstrated success in disseminating NONLIN via the Internet may lead to distribution of other existing EPSS. Interest from the design field could also promote creation of other EPSS related to design principles now taught in the MBDSI and other EMI courses. As FEMA's mitigation experts become aware of the power of EPSS as a training and performance tool, there may be more interest in capturing new design recommendations in the EPSS format rather in traditional paper-based manuals.

In some cases, such as the benefit/cost modules, EMI must be sensitive to the political concerns of State emergency management agencies regarding wide-spread distribution of tools related to decision-making on FEMA or State grant programs.

But Is it Really Training?

There is currently on-going discussion in the training field as to whether EPSS can truly be considered training. Most of us were educated in the traditional classroom mode; thus the concept of providing training absent "live" interaction with an instructor may seem heretical. However the ultimate goal of training programs has always been to provide the learner with the knowledge and skills necessary to perform a task or function. From this perspective, an EPSS provides intimate, focussed coaching for the learner - albeit through the electronic medium - offering on-the-spot information, feedback, correction and response to reinforce the learning process.

Readily Understood and Applied by Users

In this case FEMA and EMI are pragmatic organizations. When the mission is saving lives and protecting property, one tends not to quibble over definitions. Rather, the criteria for any project is "Will it work?" EMI trainers long ago moved from the philosophical orientation that would demand our trainees to carry in their memories all that they need to know, all that they need to do to meet our common

mission. For over 15 years EMI training has produced course materials that can function as reference manuals, standard operating procedures (SOP's) and job aids.

Emergency management demands competent performance, even from those who infrequently have the opportunity to perform. Utilizing EPSS as an element of our training program can give novice performers the chance to produce the expert performance owed to their citizens, to their communities.

EMI has been committed to Distance Education since its creation as an institution over 17 years ago. EPSS offers us the best chance yet to reach our distant audiences, when they most need us, with training that can truly help them perform. EPSS is a particularly appropriate training approach in response to the mandate of the National Mitigation Strategy which requires technology transfer to be done in a modality "readily understood and applied by users."[41]

"Building safer communities" must be more than a hollow slogan. For FEMA it is a strategic vision, a national goal that requires building partnerships with those professionals who are creating tomorrow's built-environment. Architects

and engineers may not have the time to come to the EMI campus. But when they encounter a challenging design problem in a disaster-prone area, EPSS and the WWW can help bring EMI to them.

Endnotes

[1] Federal Emergency Management Agency, et. al., The Northridge Earthquake: One Year Later (Washington: Federal Emergency Management Agency, 1995), 43.

> "California State University, Northridge (CSUN) President Belinda Wilson remembers, 'Every one of our major buildings was damaged to some degree, some nearly totaled. We had not one classroom or laboratory or faculty office that we could count on as 'safe space.''"

[2] Ibid. 7.

[3] Dean Flessner, State Farm Fire and Casualty Company, panelist. Quoted in 1995 U.S. Natural Hazards Symposium Proceedings, March 20-21, 1995 (Minneapolis: Earth Resources Association, 1995), 79.

> "The classic example is the Florida Joint Underwriting Association, developed in the aftermath of Hurricane Andrew, and certainly something had to be done. This was an emergency situation. The insurance market was gone, the real estate market was fading, other economic consequences were on the horizon. . . ."

[4] Federal Emergency Management Agency, National Mitigation Strategy (Washington: Federal Emergency Management Agency, 1995)(frontspiece).

[5] Ibid., i.

[6] Ibid., iii.

[7] Federal Emergency Management Agency, Partnership for a Safer Future (Washington: Federal Emergency Management Agency, 1994), 6.

[8] Federal Emergency Management Agency, National Mitigation Strategy, Appendix B-1.

[9] Ibid., 13.

[10] Ibid., 18.

[11] Ibid., 19.

[12] Ibid., 23.

[13] National Research Council, Commission on Geosciences, Environment and Resources, U.S. National Committee for the Decade for Natural Disaster Reduction, _A Safer Future: Reducing the Impacts of Natural Disasters_ (Washington: National Academy Press, 1991), 24.

> ". . . lives were saved in the Loma Prieta earthquake as a direct result of seismic design ,

[14] Heather Schoonmaker, _1994 Survey Assessment Report: Multiprotection Design Summer Institute_ (Oak Ridge: Oak Ridge Institute for Science and Education, 1994), 39.

[15] Kenneth Topping, President, Topping and Associates, telephone interview by author. 22 January 1997.

[16] Gloria J..Gery, _Electronic Performance Support Systems: How and Why to Remake the Workplace Through the Strategic Application of Technology_ (Boston: Weingarten Publications, Inc., 1991), 34.

[17] Clay Carr, "PSS! Help When You Need It," _Training and Development_, June 1992, 32.

> ". . . a performance support system, or PSS, uses computers and associated technology to provide just the help a performer needs to do a job, just when the performer needs it, and in just the form in which he or she needs it."

[18] George Stevens and Emily Stevens, "The Truth About EPSS," _Training and Development_, June 1996, 50.

> "(EPSS tools) . . .can help workers who are already fundamentally prepared for their jobs learn tasks that are performed infrequently (and so, often forgotten). They can help workers access information in text, video, or audio format, and receive advice about particularly sticky problems."

[19] Gery, 35.

[20] Del Wood, "Electronic Performance Support: 'Look Mom! No Training," Journal of Interactive Instruction Development, Fall 1995, 29.

> "An advisor offers immediate, procedural oriented assistance or advice. The procedural guidance could include step-by-step processes."

[21] Gloria J. Gery, "Attributes and Behaviors of Performance-Centered Systems," <http://www.cet.fsu.edu/SY2000/PIQ/Gery.html>, 13 January 1997.

[22]Wood, 31.

> "The wizard provides a quick and linear method to capture input from the user with a series of questions. The user provides the answers to the questions and the required input information is automatically captured. Few user interface skills are required because the wizard bypasses the user interface. Information from the wizard is transferred straight to the business application. The disadvantage is the user will not learn how to navigate through the application screens and windows. Thus the learning objective is not met."

[23] Carr, 33.

> "The dofer (a term coined by Anthony Putman), who does as much of the routine work of the job as possible, letting the performer concentrate on more important tasks."

[24] Beverly Geber, "HELP! The Rise of Performance Support Systems," Training, December 1991, 25.

> "A PSS contains CBT, but its form is what PSS advocates call 'granular' - very short tutorials that the user can call up only if needed."

[25] Geber, 24.

> "To be effective - instead of frustrating - these PSS pieces must be woven together with a hypertext authoring system which allows the user to skip around within the software, instantly finding

information or advice, seemingly without abandoning the task at hand."

[26] Lowell Briggs, Associate Professor of Communications, York College of Pennsylvania, telephone interview by author, 30 January, 1997.

[27] Bonnibeth Rogers, Case Study presented at Interactive '94, (proceedings, p. 270), summarized in "Case Studies," EPSS.Com Library, <http://www.epss.com/1b/casestud/casestud.html>, 10 February 1997.

[28] Gery, Electronic Performance Support Systems, 67-73.

[29] Stanley E. Malcolm, Ph.D., "Case Study: AETNA, the AMP Facilitator," <http://www.athenaeum.com/athena/active-a/learntec/sm-csamp.html>, 17 December 1996, 1.

[30] Geber, p.27.

> " . . . defines a mission in the Aetna sense. Then the user is led through seven steps: Identify your mission, identify critical success factors, scan and describe the environment, identify gaps, set objectives, develop action steps, and implement and monitor.
>
> "At each step of the way, the user is probed for answers to specific questions. . . .
>
> "Along the way, the PSS captures all this information and, at the end, produces an outlinesdversion of the session, complete with to-do lists."

[31]Geber, 25.

[32] Elizabeth Razzi and Ronaleen R. Roha, Kiplinger's Personal Finance Magazine, October 1996,72.

[33] Catherine L. Witt and Walter Wager, "A Comparison of Instructional Systems Design and Electronic Performance Suport Systems Design," Educational Technology, July-August 1994, 21.

[34] Briggs.

[35] Witt and Wager, 21.

[36] Federal Emergency Management Agency, National Mitigation Strategy, 23.

[37] Stephanie Wilkinson, , "In a Class by Itself," PC Week, 18 December 1995. Dialog File 275:1AC(SM), Knight-Ridder Information, ISSN:0740-1604.

> "Tony Karrer, a systems architect with Internal and External Communication Inc., in Marina Del Rey, Calif., says the biggest benefit of moving CBT to the Internet is the ability to update content rapidly."

[38] Wilkinson, 1.

> " . . . a recent study from International Data Corp., of Framingham, Mass., highlights the potential of CBT over the Internet. With the number of Internet users woldwide expected to more than double in the next four years - to 200 milliion by 1999 - the growth of Web-based training will also explode, predicts Ellen Julian, author of the study."

[39]Topping.

[40] Betty Collis, "The Internet as an Educational Innovation: Lessons from Experience with Computer Implementation," Educational Technology, November-December 1996, 25.

> "The ease with which the WWW with its search engines now allows us to access ideas and examples and images and materials through a single user interface is something which has never happened before."

[41] Federal Emergency Management Agency, National Mitigation Strategy, 23.

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